APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/589,794	08/17/2006	Sven Woop	119835-163886	8682

60172   7590   01/27/2009
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EXAMINER
HOANG, PHI

ART UNIT	PAPER NUMBER
2628	

MAIL DATE	DELIVERY MODE
01/27/2009	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

	Application No.	Applicant(s)
	10/589,794	WOOP ET AL.
Office Action Summary	Examiner	Art Unit	
	PHI HOANG	2628	

-- *The MAILING DATE of this communication appears on the cover sheet with the correspondence address* --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE <u>3</u> MONTH(S) OR THIRTY (30) DAYS,
WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.
- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed
  after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
  Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any
  earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on <u>17 August 2006</u>.
2a)☐ This action is **FINAL**.　　2b)☒ This action is non-final.
3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is
　　closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) <u>1-16</u> is/are pending in the application.
　　4a) Of the above claim(s) _____ is/are withdrawn from consideration.
5)☐ Claim(s) _____ is/are allowed.
6)☒ Claim(s) <u>1-16</u> is/are rejected.
7)☐ Claim(s) _____ is/are objected to.
8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.
10)☒ The drawing(s) filed on <u>17 August 2006</u> is/are: a)☒ accepted or b)☐ objected to by the Examiner.
　　Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
　　Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
　　a)☒ All　b)☐ Some * c)☐ None of:
　　　1.☐ Certified copies of the priority documents have been received.
　　　2.☐ Certified copies of the priority documents have been received in Application No. _____.
　　　3.☐ Copies of the certified copies of the priority documents have been received in this National Stage
　　　　　application from the International Bureau (PCT Rule 17.2(a)).
　　* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)
1)☒ Notice of References Cited (PTO-892)
2)☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3)☒ Information Disclosure Statement(s) (PTO/SB/08)
　　Paper No(s)/Mail Date <u>17 August 2006</u>.
4)☐ Interview Summary (PTO-413)
　　Paper No(s)/Mail Date. _____
5)☐ Notice of Informal Patent Application
6)☐ Other: _____.

U.S. Patent and Trademark Office
PTOL-326 (Rev. 08-06)　　　　　　　　**Office Action Summary**　　　　　　　　Part of Paper No./Mail Date 20081025

DETAILED ACTION

Claim Objections

1.   Claim 1 is objected to because of the following informalities: the claim

prematurely ends with a period ("...during ray tracing from being intersected again by

the **ray. and** wherein the device..."). MPEP 608.01(m) states: "Each claim begins with a

capital letter and ends with a period. Periods may not be used elsewhere in the claims

except for abbreviations."

Appropriate correction is required.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that

form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

2.   Claims 1-4, 6, 8-14, and 16 are rejected under 35 U.S.C. 102(b) as being

anticipated by Wrigley (US 5,933,146).

3.   Regarding claim 1, Wrigley discloses a device for the photorealistic

representation of dynamic, complex, three-dimensional scenes by means of ray-tracing,

wherein said device has at least one programmable ray-tracing processor in which are

implemented: (Figure 9)

special traversing instructions and/or (Column 10, lines 36-52)

vector arithmetic instructions and/or (Column 10, lines 8-28)

instructions for establishing ray-tracing acceleration structures and/or

at least one decision unit (mailbox), which prevents objects or triangles that have already been intersected by a ray cast during ray tracing from being intersected again by the ray;

and wherein the device is organized in such manner as to allow a plurality of threads to be processed in parallel and to allow a plurality of threads to automatically be processed synchronously, (Column 7, lines 1-20, it is well known that the task of ray tracing can be split into threads for each parallel processor to process)

and wherein the device is provided with an n-level cache hierarchy and/or virtual memory management and/or a direct link to the main memory (Figure 9, element 70).

4.   Regarding claim 2, Wrigley discloses a device for the photorealistic representation of dynamic, complex, three-dimensional scenes by means of ray tracing, wherein said device has at least one special traversal unit, (Column 10, lines 36-52)

at least one list unit,

at least one decision unit (mailbox) which prevents objects or triangles that have already been intersected by a ray cast during ray tracing from being intersected again by the ray,

at least one intersection-computation unit, (Column 6, lines 35-42)

at least one unit for establishing acceleration structures,

at least one transformation unit and/or

at least one unit for solving linear equation systems,

and wherein a plurality of rays or threads may be processed in parallel and a plurality of rays or threads may automatically be processed synchronously and an arbitrary number of dynamic-object levels may be realized in dynamic objects, (Column 7, lines 1-20, it is well known that the task of ray tracing can be split into threads for each parallel processor to process)

and wherein the device is provided with an n-level cache hierarchy and/or virtual memory management and/or a direct link to the main memory (Figure 9, element 70).

5.   Regarding claim 3, Wrigley discloses said device has at least one special traversal unit, at least one list unit, at least one decision unit (mailbox) which prevents objects or triangles that have already been intersected by a ray cast during ray tracing from being intersected again by the ray, at least one intersection-computation unit, at least one unit for establishing acceleration structures and at least one ray-tracing processor (Figure 9).

6.   Regarding claim 4, Wrigley discloses at least one unit for establishing acceleration structures is realized by means of special hardware or by programmable units or ray-tracing processors, and functionally carries out processes for creating the data structure for the acceleration structure and for deciding whether a triangle or a box overlaps another box, (Column 18, line 64 – column 19, line 32) the at least one unit basing the decision on comparisons of the vertices of the triangle or box with the vertices of the second box and--if no decision is possible--making a conservative decision or, in this case, starting a program on the programmable ray-tracing processor,

with said program making the exact decision, or an additional, special hardware unit makes the exact decision or the entire computation takes place on the ray-tracing processor (Column 19, lines 33-40).

7.   Regarding claim 6, Wrigley discloses the at least one traversal unit or traversal instruction is able not only to traverse along a ray but is also able to traverse a volume, so that all objects within this volume can be processed (Column 9, line 55 – column 10, line 2).

8.   Regarding claim 8, Wrigley discloses the function of the at least one traversal unit and the hardware implementation of the traversing instructions are based on the fact that a ray is traversed through an acceleration structure based on the kD-tree technique or the octree technique or the uniform-grid technique or the bounding-volume-hierarchy technique, with simplified geometry data being stored in each acceleration-structure node and being used as soon as the ray cone under consideration passes through the bigger part of the volume belonging to this node (Column 9, line 55 – column 10, line 28).

9.   Regarding claim 9, Wrigley discloses a plurality of ray-tracing units operate in parallel on a plurality of chips and/or a plurality of printed circuit boards (Figure 9).

10.   Regarding claim 10, Wrigley discloses the described ray-tracing hardware additionally uses a space-dividing data structure in which spatial influences and/or material-modifying parameters are stored, which are evaluated with the already available and/or additional functional units (Column 3, lines 1-9).

11.   Regarding claim 11, Wrigley discloses the ray-tracing hardware processes three-
dimensional scenes that are not built up exclusively from triangles but also contain other
geometric objects which, where necessary, are transformed into different geometric
objects and/or processed directly with additional and/or already available functional
units and/or the programmable ray-tracing processor (Column 6, lines 35-42 and figure
5).

12.   Regarding claim 12, Wrigley discloses the described ray-tracing hardware
processes three-dimensional scenes and computes several, one or no ray-object
intersections, sorted or unsorted according to the distance, per ray, where the number
of ray-object intersections may be defined as a constant and/or described by additional
object parameters (Column 9, lines 9-20 and column 11, lines 27-56).

13.   Regarding claim 13, Wrigley discloses the described ray-tracing hardware is
able, using additional and/or the already available functional units, to count how often a
dynamic and/or geometric object and/or a material description and/or an element and/or
a subgroup of the space-description data structure and/or a program and/or a memory
cell and/or a memory page was used to compute an image (Column 15, lines 35-49).

14.   Regarding claim 14, Wrigley discloses the described ray-tracing hardware is
able, using additional or the already-available functional units, to compute space-
description data structures for partial or complete three-dimensional scenes, with
additional parameters for each dynamic object and/or dynamic sub-object and/or

geometric object influencing the manner in which the space-description data structure is

computed (Column 2, lines 15-35).

15.   Regarding claim 16, Wrigley discloses a plurality of ray-tracing units operate in

parallel and the required computation data is distributed on the memories of these ray-

tracing units and when needed, is downloaded from whichever unit the required data is

stored in (Figure 9).

Claim Rejections - 35 USC § 103

16.   The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all

obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set
> forth in section 102 of this title, if the differences between the subject matter sought to be patented and
> the prior art are such that the subject matter as a whole would have been obvious at the time the
> invention was made to a person having ordinary skill in the art to which said subject matter pertains.
> Patentability shall not be negatived by the manner in which the invention was made.

17.   Claim 5 is rejected under 35 U.S.C. 103(a) as being unpatentable over Wrigley

(US 5,933,146) in view of Lathrop (US 6,597,359 B1).

18.   Regarding claim 5, Wrigley discloses all limitations as discussed in claim 3.

        Wrigley does not clearly disclose the at least one transformation unit and/or the

at least one logic unit for solving linear equation systems is used functionally for

primary-ray generation and/or object-space transformation and/or normalized-triangle-

space transformation and/or reflection-ray computation and/or transparency-ray

computation and or shadow-ray computation and/or the transformation of normals.

        Lathrop discloses the at least one transformation unit and/or the at least one

logic unit for solving linear equation systems is used functionally for primary-ray
generation and/or object-space transformation and/or normalized-triangle- space
transformation and/or reflection-ray computation and/or transparency-ray computation
and or shadow-ray computation and/or the transformation of normals (Column 11, lines
1-35, a transformation is performed by the apparatus and tracing is performed in a new
coordinate space)

Therefore, it would have been obvious to a person of ordinary skill in the art at
the time the invention was made to modify Wrigley to calculate transformations for
objects as disclosed by Lathrop because objects to be traced can be placed in different
positions or alter its position to a desired coordinate system for tracing.

19.   Claim 7 is rejected under 35 U.S.C. 103(a) as being unpatentable over Wrigley
(US 5,933,146).

20.   Regarding claim 7, Wrigley discloses all limitations as discussed in claim 1.

Wrigley does not clearly disclose the at least one traversal unit or traversal
instruction is able not only to traverse along a ray but also along a ray cone or a ray
pyramid, so that all objects located within the ray cone or the ray pyramid can be
processed from front to back. However, Wrigley discloses traversal with a sphere
(Column 9, line 55 – column 10, line 2). It would have been obvious s to a person of
ordinary skill in the art to traverse a cone or a pyramid because they are known shapes
that can be traced similarly to a sphere.

21.   Claim 15 is rejected under 35 U.S.C. 103(a) as being unpatentable over Wrigley
(US 5,933,146) in view of Buehler (US 2003/0160788 A1).

22.   Regarding claim 15, Wrigley discloses all limitations as discussed in claim 1.

        Wrigley does not disclose the described ray-tracing hardware is connected via a
shared z buffer and frame buffer with rasterization hardware that is located on the same
chip as the ray- tracing hardware or on a separate chip.

        Buehler discloses the described ray-tracing hardware is connected via a shared z
buffer and frame buffer with rasterization hardware that is located on the same chip as
the ray- tracing hardware or on a separate chip (Figure 2 and page 2, paragraphs 0022
- 0025).

        Therefore, it would have been obvious to a person of ordinary skill in the art at
the time the invention was made to modify Wrigley to use buffers and other rasterization
hardware as disclosed by Buehler because hardware such as z buffers are well known
components used in three dimensional graphics processing because z buffers typically
hold depth values for polygons.

                                    Conclusion

        Any inquiry concerning this communication or earlier communications from the
examiner should be directed to PHI HOANG whose telephone number is (571)270-
3417. The examiner can normally be reached on Mon-Fri, 8:30am-5:00pm EST.

        If attempts to reach the examiner by telephone are unsuccessful, the examiner's

supervisor, Xiao Wu can be reached on 571-272-7761. The fax phone number for the

organization where this application or proceeding is assigned is 571-273-8300.

        Information regarding the status of an application may be obtained from the

Patent Application Information Retrieval (PAIR) system. Status information for

published applications may be obtained from either Private PAIR or Public PAIR.

Status information for unpublished applications is available through Private PAIR only.

For more information about the PAIR system, see http://pair-direct.uspto.gov. Should

you have questions on access to the Private PAIR system, contact the Electronic

Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a

USPTO Customer Service Representative or access to the automated information

system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/Phi Hoang/
Examiner, Art Unit 2628
January 16, 2009

/XIAO M. WU/
Supervisory Patent Examiner, Art Unit 2628